

AMENDMENTS TO THE CLAIMS:

Following is a listing of all claims in the present application, which listing supersedes all previously presented claims:

Listing of Claims:

1. (Currently Amended) A printed circuit board including a dielectric substrate and integrated with a two-axis fluxgate sensor, comprising:
 - a first rectangular ring type soft magnetic core arranged~~formed~~ lengthwise along~~in~~ a first axial direction~~direction and forming a rectangular ring~~;
 - a first excitation coil portion winding~~formed~~ of a metal film and wound around the first soft magnetic core;
 - a first pick-up coil portion winding~~formed~~ of a metal film and wound around the first soft magnetic core~~core and the first excitation coil~~;
 - a second rectangular ring type soft magnetic core arranged~~formed~~ lengthwise along~~in~~ a second axial direction, the second axial direction being perpendicular to the first axial direction~~direction and forming a rectangular ring~~;
 - a second excitation coil portion winding~~formed~~ of a metal film and wound around the second soft magnetic core; and
 - a second pick-up coil portion winding~~formed~~ of a metal film and wound around the second soft magnetic core~~core and the second excitation coil~~,

wherein the printed circuit board includes a single dielectric core and the first excitation coil, the first pick-up coil, and the first soft magnetic core is~~are~~ disposed on a first side of the dielectric substrate~~the printed circuit board and the second excitation coil, the second pick-up coil, and the second soft magnetic core is~~~~are~~ disposed on a second side of the dielectric substrate~~printed circuit board~~.

2.-16. (Canceled).

17. (Currently Amended) The printed circuit board as claimed in claim 1, wherein each of the first and second soft magnetic cores comprises a first parallel pair of bar-type portions extending along the first axial direction and a second parallel pair of bar-type portions extending along the second axial direction and the first and second soft magnetic cores extend along a plane that is substantially parallel to the dielectric substrate, wherein each of the first and second soft magnetic cores serves as a closed magnetic path, four co-planar bars forming the rectangular ring.

18. (Currently Amended) The printed circuit board as claimed in claim 17, wherein each of the first and second excitation coil portion separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction and the second excitation coil portion separately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core coils has a structure of winding at least two opposing sides of the rectangular ring in an axial direction and substantially in a solenoid pattern extending along the second axial direction, pattern.

19. (Currently Amended) The printed circuit board as claimed in claim 18, wherein:wherein each of

the first and second pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction. coils has a structure of winding the at least two opposing sides of the rectangular ring in an axial direction together and substantially in a solenoid pattern.

20. (Currently Amended) The printed circuit board as claimed in claim 19, wherein claim 17, wherein:

along a plane substantially perpendicular to the dielectric substrate, the first excitation coil portion winds around one of the bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core and the first pick-up coil portion winds around the other of the bar-type portions of the first parallel portions of the first soft magnetic core, the first excitation and

along a plane substantially perpendicular to the dielectric substrate, the second excitation coil portion winds around one of the bar-type portions of the first parallel pair of bar-type portions of the second soft magnetic core and the second pick-up coil portion winds around the other of the bar-type portions of the first parallel pair of bar-type portions of the second soft magnetic core. pick-up coils and the second excitation and pick-up coils have a structure of winding the at least two opposing sides of the rectangular ring in an alternating fashion.

21. (Currently Amended) The printed circuit board as claimed in claim 20, claim 17,

wherein:

each of the first excitation coil portion and the first pick-up coil portion includes a plurality of first upper portions on the first side of the dielectric substrate and a plurality of corresponding first lower portions on the first side of the dielectric substrate, the first upper portions being further from the first side of the dielectric substrate than the corresponding first lower portions,

each of the second excitation coil portion and the second pick-up coil portion includes a plurality of second upper portions on the second side of the dielectric substrate and a plurality of corresponding second lower portions on the second side of the dielectric substrate, the second upper portions being arranged further from the second side of the dielectric substrate than the corresponding second lower portions,

the plurality of first upper portions of the first pick-up coil portion and the plurality of first upper portions of the first excitation coil portion corresponding to a patterned first upper conductive film,

the plurality of corresponding first lower portions of the first pick-up coil portion and the plurality of first lower portions of the first lower portions of the first excitation coil corresponding to a patterned first lower conductive film,

the plurality of first upper portions of the first pick-up coil portion being electrically connected with the plurality of corresponding first lower portions of the first pick-up coil portion by way of vias, and

the plurality of first upper portions of the first excitation coil portion being electrically connected with the plurality of corresponding first lower portions of the first excitation coil

portion by way of vias, wherein each coil of the first and second excitation coils and each coil of the first and second pick-up coils is wound once and substantially in a zigzag fashion, such that the first and second excitation coils and the first and second pick-up coils face each other with the intervention of the rectangular ring therebetween.

22. (Currently Amended) The printed circuit board as claimed in claim 21,
wherein: claim 18, wherein

each of the first upper portions of the first excitation coil portion substantially faces the first corresponding lower portion of the first excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion and the corresponding first lower portion of the first excitation coil portion, and

each of the second upper portions of the second excitation coil portion substantially faces the second corresponding lower portion of the second excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion and the corresponding second lower portion of the second excitation coil portion. each of the first and second pick-up coils has a structure of winding the at least two opposing sides of the rectangular ring substantially in a solenoid pattern.

23. (Currently Amended) The printed circuit board as claimed in claim 22, wherein:
each of the first upper portions of the first pick-up coil portion substantially faces the first corresponding lower portion of the first pick-up coil portion with at least one of the bar-type

portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion and the corresponding first lower portion of the first pick-up coil portion, and

each of the second upper portions of the second pick-up coil portion substantially faces the second corresponding lower portion of the second pick-up coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion and the corresponding second lower portion of the second pick-up coil portion. claim 22, wherein the first excitation and pick-up coils and the second excitation and pick-up coils have a structure of winding the at least two opposing sides of the rectangular ring in an alternating fashion.

24. (Currently Amended) The printed circuit board as claimed in claim 21, wherein:

each of the first upper portions of the first excitation coil portion substantially faces the first corresponding lower portion of the first pick-up coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between the first upper portion of the first excitation coil and the corresponding first lower portion of the first pick-up coil portion, and

each of the second upper portions of the second excitation coil portion substantially faces the second corresponding lower portion of the second pick-up coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion of the second excitation coil portion and the corresponding second lower portion of the second pick-up coil portion. claim 23, wherein each coil of the first and second excitation coils and each coil of the first and second

~~pick-up coils is wound once and substantially in a zigzag fashion, such that the first and second excitation coils and the first and second pick-up coils face each other with the intervention of the rectangular ring therebetween.~~

25. (Currently Amended) The printed circuit board as claimed in claim 24, wherein:
each of the first upper portions of the first pick-up coil portion substantially faces the first corresponding lower portion of the first excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the first soft magnetic core extending between and overlapping the first upper portion of the first pick-up coil portion and the corresponding first lower portion of the first excitation coil portion, and
each of the second upper portions of the second pick-up coil portion substantially faces the second corresponding lower portion of the second excitation coil portion with at least one of the bar-type portions of the first pair of parallel bar-type portions of the second soft magnetic core extending between and overlapping the second upper portion of the second pick-up coil portion and the corresponding second lower portion of the second excitation coil portion.claim 17, wherein each of the first and second excitation coils are wound around at least two opposing sides of the rectangular ring in an axial direction and substantially in a figure-eight pattern.

26. (Currently Amended) The printed circuit board as claimed in claim 17, wherein:
the first excitation coil portion alternately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a figure-eight pattern extending along the first axial direction, and

the second excitation coil portion alternately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a figure eight pattern extending along the second axial direction. ~~claim 25, wherein each of the first and second pick-up coils has a structure of winding the at least two opposing sides of the rectangular ring in axial direction together and substantially in a solenoid pattern.~~

27. (Currently Amended) The printed circuit board as claimed in claim 26, ~~wherein~~wherein:

the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction, and

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction. ~~the first excitation and pick-up coils and the second excitation and pick-up coils have a structure of winding the at least two opposing sides of the rectangular ring in an alternating fashion.~~

28. (Currently Amended) The printed circuit board as claimed in claim 26, wherein: claim 27, wherein

the first pick-up coil portion alternately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a figure-eight pattern extending along the first axial direction,

the second pick-up coil portion alternately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a figure eight pattern extending along the second axial direction,

the winding of the first pick-up coil portion is off-set from the winding of the first excitation coil portion, and

the winding of the second pick-up coil portion is off-set from the winding of the second excitation coil portion, each coil of the first and second excitation coils and each coil of the first and second pick-up coils is wound once and substantially in a zigzag fashion, such that the first and second excitation coils and the first and second pick-up coils face each other with the intervention of the rectangular ring therebetween.

29. (Currently Amended) The printed circuit board as claimed in claim 25, wherein claim 26, wherein:

the first pick-up coil portion separately winds around each bar-type portion of the first parallel pair of bar-type portions of the first soft magnetic core in a solenoid pattern extending along the first axial direction and the second pick-up coil portion separately winds around each bar-type portion of the second parallel pair of bar-type portions of the second soft magnetic core in a solenoid pattern extending along the second axial direction.

the winding of the first pick-up coil portion is off-set from the winding of the first excitation coil portion, and

the winding of the second pick-up coil portion is off-set from the winding of the second excitation coil portion, each of the first and second pick-up coils has a structure of winding the at

~~least two opposing sides of the rectangular ring in axial direction and substantially in a solenoid pattern.~~

30. (Currently Amended) The printed circuit board as claimed in ~~claim 29~~,
wherein~~claim 17, wherein:~~

the first pick-up coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction,

the second pick-up coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction,

the first excitation coil portion winds around both bar-type portions of the first parallel pair of bar-type portions of the first soft magnetic core together in a solenoid pattern extending along the first axial direction,

the second excitation coil portion winds around both bar-type portions of the second parallel pair of bar-type portions of the second magnetic core together in a solenoid pattern extending along the second axial direction,

the winding of the first pick-up coil portion is off-set from the winding of the first excitation coil portion, and

the winding of the second pick-up coil portion is off-set from the winding of the second excitation coil portion ~~the first excitation and pick-up coils and the second excitation and pick-up coils have a structure of winding the at least two opposing sides of the rectangular ring in an alternating fashion.~~

31. (Currently Amended) The printed circuit board as claimed in claim 17, wherein
the first excitation coil portion is electrically connected to the second excitation coil portion by a
via and the first pick-up coil portion is electrically connected to the second pick-up coil portion
by a via. ~~claim 30, wherein each coil of the first and second excitation coils and each coil of the~~
~~first and second pick-up coils is wound once and substantially in a zigzag fashion, such that the~~
~~first and second excitation coils and the first and second pick-up coils face each other with the~~
~~intervention of the rectangular ring therebetween.~~

32-64. (Cancelled)